Boron carbide (B4C) is one of the most important opaque boride ceramics that has high hardness and Young's modulus that along with low density lead to a significant resistance to ballistic impact and, thus, B4C is broadly used as a protective material. B4C has also high neutron capturing cross section; therefore, it is used as control rods and neutron absorption shielding in nuclear reactors. In this work thermal, electrical and mechanical properties of dense B4C ceramics (99%) sintered using Spark Plasma Sintering (SPS) were investigated. The Young's modulus of B4C measured by three different techniques - IE, RUS, and nanoindentation showed a very good overlap in values, which ranges from 431.9+-2 GPa for nanoindentation to 458.7 GPa for RUS measurements at room temperature. The mean contact pressure-contact depth plots obtained from load-displacement nanoindentation data indicated pop-in events during loading and an "elbow" event during unloading, both of which are indicative of possible structural changes in B4C structure during nanoindentation. The appearance of "elbow" deviations in load-displacement nanoindentation curves of B4C was detected for the first time. The 4-point bending strength of the B4C ceramics was equal to 585+-70 MPa with Weibull parameter of 9.9 and scale parameter equal to 611 MPa. The biaxial strength of B4C was measured to be much lower and equal to 238.6+-122 MPa with Weibull parameters of 2.2 and scale parameter equal to 271 MPa. To the best of our knowledge the biaxial strength of B4C was also measured for the first time. In this work it was determined that failure of B4C occurred by fully transgranular fracture, with no intergranular failure present on fracture surface. B4C's fracture toughness $K_{lc} = 3+-0.19$ MPa*√m was measured using SEVNB technique, which is similar to previously reported values.

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Approved for distribution by Nina Orlovskaya, Committee Chair, on March 6, 2020.

The public is welcome to attend.